AlGaN films and AlGaN/GaN superlattices prepared by hot wall epitaxy

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AlGaN/GaN superlattices are useful for cladding layers or contact layer of AlInGaN light emitting devices of visible to ultraviolet region because low resistivity superlattices are obtained owing to a shallowing of Mg acceptor level: valence band offset of the heterojunction and piezoelectric effect cause the shallowing of the acceptor level. The AlGaN/GaN superlattices or quantum wells are also expected as high power intersubband quantum cascade laser application because of the thermal stability of the AlGaN. High quality GaN, AlGaN, and InGaN films have been prepared by MOCVD, MBE, etc. Hot wall epitaxy is also useful to prepare AlInGaN films and superlattices, and we prepared high quality GaN, and InGaN films as reported before[1,2]. In this paper, we describe preparation and properties of AlGaN films and AlGaN/GaN superlattices using the hot wall epitaxy. Figure 1 shows the HWE system to prepare AlGaN and AlGaN/GaN superlattices. HW I is for nitridation of substrate and Ga predeposited layer[1], and HW II is for the growth of GaN and AlGaN films, and superlattices. In AlGaN film growth, Ga metal, and TMA and NH_3 gases were used as source materials. AlGaN/GaN superlattices were prepared interrupting TMA gas flow periodically. Streak RHEED patterns showing epitaxial growth were observed for the AlGaN films up to 40% AlN content. Figure 2 shows X-ray diffraction patterns of AlGaN/GaN superlattices around (0004) reflection. The superlattices consists of 20 periods of AlGaN(20nm) and GaN(2-20nm) layers, and the thickness of each layer is indicated in the figure. In the superlattices, lattice constant difference between AlGaN and GaN causes tensile strain in AlGaN layers and compressive strain in GaN layers, and lattice spacing difference along [0001] direction between AlGaN and GaN increases. Theoretical X-ray diffraction patterns of the superlattices are also shown by dashed lines in the Fig.2. Though the satellite peaks are not well separated owing to the fluctuation of AlN content in AlGaN layers, the experimental patterns agree well with the theoretical ones.

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2) S.Chen, T.Saisho, K.Fujimura, S.Sakakibara, F.Tanoue, K.Ishino, A.Ishida, H.Harima, Y.Oka, K.K.Takahiro, Y.Chen, T.Yao, and H.Fujiyasu, Jpn.J.Appl.Phys. 38, 4973-4979(1999).

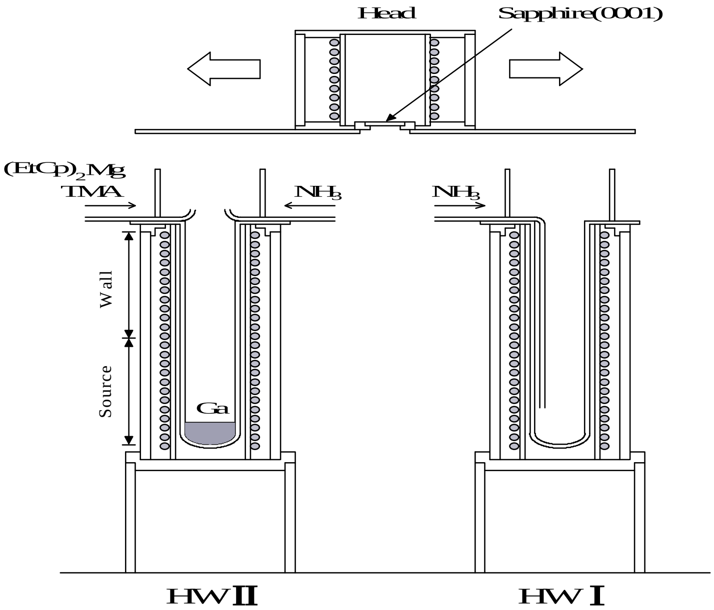

Fig.1. HWE system used to prepare AlGaN and AlGaN/GaN superlattices.

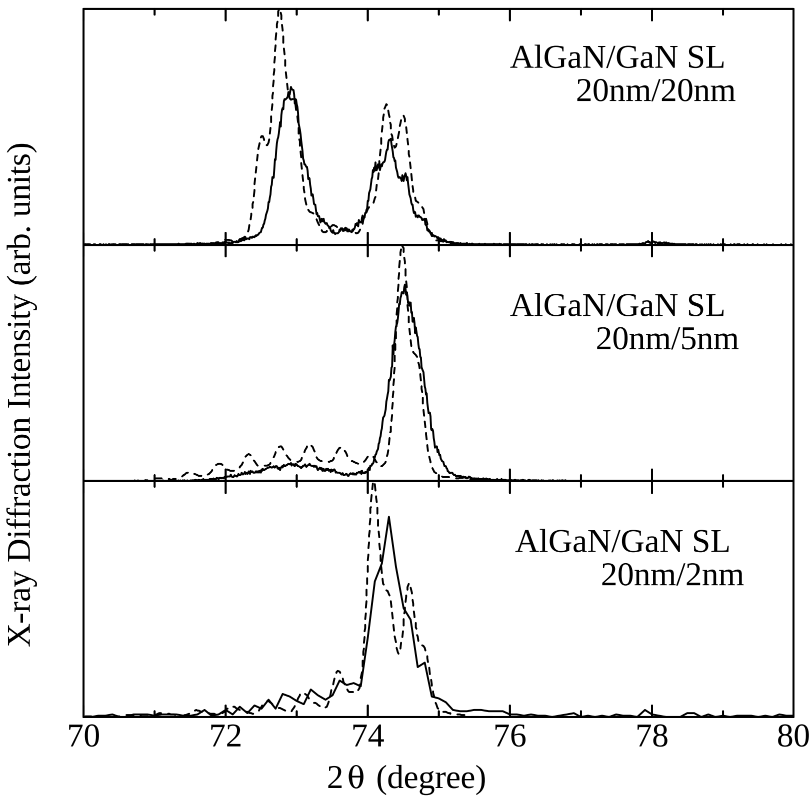

Fig.2. X-ray diffraction patterns around (0004) reflection of $Al_{0.4}Ga_{0.6}N$/GaN superlattices. Solid curves show experimental results and dashed curves show theoretical patterns.